

In the Specification

Kindly replace paragraph [0001] and [0002] with the following:

RELATED APPLICATION

This is a §371 of International Application No. PCT/JP2005/001555, with an international filing date of January 27, 2005 (WO 2005/073422 A1, published August 11, 2005), which is based on Japanese Patent Application Nos. 2004-021283, filed January 29, 2004, 2004-074033, filed March 16, 2004 and 2004-073862, filed March 16, 2004.

TECHNICAL FIELD

The ~~present~~ invention relates to a low Ni and high N stainless steel having an austenite and ferrite (two-phase) structure.

BACKGROUND-ART

Stainless steels are used in wide fields including automobile members, construction members, and kitchenware as high corrosion resistance materials. As of these applications, wheel cap of automobile, and the like, request a material having both high punch stretchability and high crevice corrosion resistance. Stainless steels are generally grouped, based on the structure of the steel, into four categories: austenitic stainless steels, ferritic stainless steels, austenitic-ferritic stainless steels, and martensitic stainless steels. As of these stainless steels, the austenitic stainless steels represented by SUS304 and SUS301 (specified by Japanese Industrial Standard (JIS)) are most widely used owing to their excellent corrosion resistance and workability. Accordingly, the austenitic stainless steel sheets are generally adopted by the wheel cap of automobile.

Kindly replace paragraphs [0024] through [0026] with the following:

DISCLOSURE OF THE INVENTIONSUMMARY

~~The inventors of the present invention gave evaluation of~~We evaluated the formability on stainless steels having various ingredients and steel structures to improve the formability of stainless steels other than austenitic stainless steels containing expensive Ni.

The evaluation derived a finding that austenitic-ferritic stainless steels show particularly high ductility in some cases. ~~The inventors of the present invention~~We studied the causes of the phenomenon in detail, and found that the percentage of austenite phase and the content of C and N in the austenite phase significantly affect the ductility, and that, in particular, further high ductility can be attained by adjusting the strain stability of the austenite phase to an appropriate range, which strain stability of austenite phase is defined by the content of C, N, Si, Mn, Cr, Ni, Cu, and Mo in the austenite phase. Furthermore, ~~the inventors~~we found that the austenitic-ferritic stainless steel which gives high ductility is also superior in the deep drawability, ~~thus the inventors have completed the present invention.~~

~~To solve the above described problems, the inventors of the present invention~~We also conducted detail study of various kinds of austenitic-ferritic stainless steels containing 1% by mass or less Ni and 0.05% by mass or more N.

Kindly replace paragraphs [0029] through [0037] with the following:

Furthermore, the study found that the Si content of the steel affects the precipitation behavior of chromium nitride, and derived the finding that the intergranular corrosion resistance improves when the Si content of steel is 0.4% by mass or less, ~~which has then led the completion of the present invention.~~

That is, the austenitic-ferritic stainless steels ~~according to the present invention are~~include at least the following-:

1 The austenitic-ferritic stainless steel has a metal structure which contains ferrite phase and austenite phase. The amount of (C + N) in the austenite phase is in a range from about 0.16 to about 2% by mass, and the volume percentage of the austenite phase is in a range from about 10 to about 85%.

2. The austenitic-ferritic stainless steel according to 1 has about 48% or larger total elongation determined by tensile test.

3. The austenitic-ferritic stainless steel according to 1 or 2 contains about 0.2% or less C, about 4% or less Si, about 12% or less Mn, about 0.1% or less P, about 0.03% or less S, about 15 to about 35% Cr, about 3% or less Ni, about 0.05 to about 0.6% N, by mass, and balance of Fe and inevitable impurities.

4. The austenitic-ferritic stainless steel according to 3 contains about 10% or less Mn, about 1 to about 3% Ni, by mass, and balance of Fe and inevitable impurities.

5. The austenitic-ferritic stainless steel according to 3 contains about 1.2% or less Si, about 2% or less Mn, about 1% or less Ni, by mass, and balance of Fe and inevitable impurities.

6. The austenitic-ferritic stainless steel according to 3 contains about 1.2% or less Si, about 4 to about 12% Mn, about 1% or less Ni, by mass, and balance of Fe and inevitable impurities.

7. The austenitic-ferritic stainless steel according to 3 contains about 0.4% or less Si, about 2 to about 4% Mn, about 1% or less Ni, by mass, and balance of Fe and inevitable impurities.

8. An austenitic-ferritic stainless steel showing excellent deep drawability is a stainless steel having an austenite and ferrite two-phase structure, containing about 0.2% or less C, about 4% or less Si, about 10% or less Mn, about 0.1% or less P, about 0.03% or less S, about 15 to about 35% Cr, about 1 to about 3% Ni, about 0.05 to about 0.6% N, by mass, and balance of Fe and inevitable impurities. The amount of (C + N) in the austenite phase is in a range from about 0.16 to about 2%

by mass, and the volume percentage of the austenite phase is in a range from about 10 to about 85%.

9. An austenitic-ferritic stainless steel showing excellent punch-stretchability and crevice corrosion resistance contains about 0.2% or less C, about 1.2% or less Si, about 2% or less Mn, about 0.1% or less P, about 0.03% or less S, about 15 to about 35% Cr, about 1% or less Ni, about 0.05 to about 0.6% N, by mass, and balance of Fe and inevitable impurities. The percentage of the austenite phase in the metal structure is in a range from about 10 to about 85% by volume.

10. An austenitic-ferritic stainless steel showing excellent corrosion resistance at welded part contains about 0.2% or less C, about 1.2% or less Si, about 4 to about 12% Mn, about 0.1% or less P, about 0.03% or less S, about 15 to 35% Cr, about 1% or less Ni, about 0.05 to about 0.6% N, by mass, and balance of Fe and inevitable impurities. The percentage of the austenite phase is in a range from about 10 to about 85% by volume.

11. An austenitic-ferritic stainless steel showing excellent intergranular corrosion resistance contains about 0.2% or less C, about 0.4% or less Si, about 2 to about 4% Mn, about 0.1% or less P, about 0.03% or less S, about 15 to about 35% Cr, about 1% or less Ni, about 0.05 to about 0.6% N, by mass, and balance of Fe and inevitable impurities. The percentage of the austenite phase is in a range from about 10 to about 85% by volume.

12. The austenitic-ferritic stainless steel according to any of 3 to 11, wherein the stainless steel further contains one or more of about 4% or less Mo and about 4% or less Cu, by mass.

13. The austenitic-ferritic stainless steel according to any of 3 to 12, wherein the stainless steel further contains about 0.5% or less V, by mass.

14. The austenitic-ferritic stainless steel according to any of 3 to 13, wherein the stainless steel further contains about 0.1% or less Al, by mass.

15. The austenitic-ferritic stainless steel according to any of 3 to 14, wherein the stainless steel further contains one or more of about 0.01% or less B, about 0.01% or less Ca, about 0.01% or less Mg, about 0.1% or less REM, and about 0.1% or less Ti, by mass.

16. The austenitic-ferritic stainless steel according to any of 9 to 15 has the amount of (C + N) in the austenite phase in a range from about 0.16 to about 2% by mass.

~~According to the present invention, there~~ There is provided an austenitic-ferritic stainless steel which has high formability giving excellent ductility and deep drawability at low cost without containing large amount of expensive Ni. Since the austenitic-ferritic stainless steel ~~according to the present invention~~ gives excellent formability, the stainless steel is suitable for the uses subjected to severe punch stretching and deep drawing, and to hydraulic forming such as hydroforming, in such fields of automobile members, building members, and kitchenware.

Owing to the low Ni content, the austenitic-ferritic stainless steel ~~according to the present invention~~ has excellent punch stretchability and crevice corrosion resistance in spite of its relatively low cost. Consequently, the austenitic-ferritic stainless steel ~~according to the present invention~~ allows fabricating complex shape works such as automobile wheel cap economically without fear of seasoned cracks.

In addition, ~~the present invention provides~~ we provide an austenitic-ferritic stainless steel which has excellent corrosion resistance at welded part while saving the Ni resource. With the characteristic, the corrosion resistant materials become available economically in high-chloride environment such as seawater, in severe corrosive environment such as oil wells, and the like.

Furthermore, ~~the present invention provides~~ we provide an austenitic-ferritic stainless steel sheet having excellent corrosion resistance even with low Ni content and high N content owing to the sensitization to prevent deterioration in the corrosion resistance. Since, furthermore, the stainless

steel sheet ~~according to the present invention~~ has low Ni content, the steel sheet is preferable in view of environmental protection and of economy. ~~With the above-described superior characteristics, the present invention is a kind of industrially contributing one.~~

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a graph showing the effect of the amount of (C + N) in the austenite phase and the percentage of austenite phase on the total elongation of the austenitic-ferritic stainless steels ~~according to the present invention.~~

Figure 2 is a graph showing the relation between the total elongation and the strain-induced martensite index ($Md(\gamma)$) of austenite phase of the austenitic-ferritic stainless steels ~~according to the present invention.~~

Figure 3 is a graph showing the relation between the total elongation and the limited drawing ratio (LDR) of the austenitic-ferritic stainless steels ~~according to the present invention.~~

Kindly replace paragraphs [0045] through [0050] with the following:

~~BEST MODE FOR CARRYING OUT THE INVENTION~~DETAILED DESCRIPTION

The description of selected, representative stainless steels ~~according to the present invention~~ is given below.

- (1) Austenitic-ferritic stainless steel having high formability with excellent ductility and deep drawability

The stainless steel ~~according to the present invention~~ is an austenitic-ferritic stainless steel composed mainly of austenite phase and ferrite phase. ~~The present invention is based on the finding~~We found that the volume percentage of the austenite phase and the content of C and N in the austenite phase significantly affect the formability of the austenitic-ferritic stainless steel composed mainly of the above two phases, and on the defining of their optimum values. ~~In the stainless steel~~

~~according to the present invention, the~~ The steel structure other than the austenite phase and the ferrite phase is occupied mainly by martensite phase.

The austenitic-ferritic stainless steel ~~according to the present invention is required to have~~ has 10 to 85% by volume of the austenite phase to the total steel structure. If the percentage of austenite phase is smaller than 10%, the amount of austenite phase excellent in ductility becomes small so that high formability cannot be attained. If the percentage of austenite phase exceeds 85%, stress corrosion cracking (SCC) appears. Therefore, a preferred range of the percentage of austenite phase is from 15 to 80% by volume.

The percentage of austenite phase is the volume percentage of austenite in the structure, and can be determined typically by observing the steel structure using a microscope, and by determining the percentage of austenite phase in the structure using linear analysis or areal analysis. Specifically, when a sample is polished, and then is etched in a red prussiate solution (potassium ferricyanide ($K_3[Fe(CN)_6]$) 30 g + potassium hydroxide (KOH) 30 g + water (H_2O) 60 ml), observation using a light microscope identifies the ferrite phase in gray, and the austenite phase and the martensite phase in white. Thus, the percentage of gray zone and of white zone, respectively, is determined by image analysis to adopt the percentage of white zone as the percentage of austenite phase. In strict meaning, however, the method cannot separately identify between the austenite phase and the martensite phase, thus the white zone may include the martensite phase other than the austenite phase. Nevertheless, even in the case of inclusion of martensite phase in the white zone, the target effect ~~of the present invention~~ is attained if only the percentage of austenite phase determined by the method and other conditions are satisfied.

The above-described volume percentage of the austenite phase can be controlled by adjusting the steel composition and the annealing condition (temperature and time) in the final annealing step.

Specifically, the percentage of austenite phase increases with the decrease in Cr, Si, and Mo contents and with the increase in C, N, Ni, and Cu contents. Excessively high annealing temperature decreases the percentage of austenite phase. On the other hand, excessively low annealing temperature induces precipitation of C and N as carbide and nitride to decrease the solid solution amount, which deteriorates the contribution to the formation of austenite phase, thereby also decreasing the percentage of austenite phase. That is, depending on the steel composition, there is a temperature range to attain the maximum percentage of austenite phase, and the temperature range with the composition according to the present invention is from 700°C to 1300°C. Although longer annealing time is more preferable because the percentage of austenite phase comes close to that in equilibrium state which is determined by the steel composition and the temperature, the time about 30 seconds or more is sufficient.

The austenitic-ferritic stainless steel according to the present invention is required to contain 0.16 to 2% by mass of the amount of (C + N) in the austenite phase. If the amount of (C + N) in the austenite phase is smaller than 0.16% by mass, the strength of strain-induced martensite phase becomes small, which fails to attain sufficient formability. If the amount of (C + N) exceeds 2% by mass, large amount of carbide and nitride precipitates during cooling stage after the annealing, which rather inversely affects the ductility. A preferable range of the amount of (C + N) is from 0.2 to 2% by mass.

Kindly replace paragraphs [0052] through [0055] with the following:

Although there is no detail analysis of the causes of the effect of volume percentage of austenite phase and of the amount of (C + N) in the austenite phase on the formability, ~~the inventors of the present invention~~ we speculate the mechanism of the phenomenon as follows.

When a steel is subjected to tensile deformation, the steel generally induces uniform deformation, followed by generating local necking (constriction), then results in fracture. Since, however, the stainless steels ~~according to the present invention has~~ herein have austenite phase, once a fine necking occurs, the austenite phase at the necking part begins strain-induced transformation to martensite phase to become harder than other parts. As a result, the necking at the part stops ~~progress~~ its progression. Instead of the progress of necking at the part, deformation on other parts proceeds to give uniform deformation over the steel, thereby providing high ductility. In particular, the stainless steels herein having large amount of (C + N) in the austenite phase ~~according to the present invention has~~ high hardness of martensite phase generated at necking part, compared with other stainless steels containing smaller amount of (C + N) in the austenite phase even with the same percentage of austenite phase, thus the effect of improving ductility by the strain-induced martensite phase is ~~presumably appeared effectively~~ present. In particular, C and N in the austenite phase significantly vary their degree of enriching into the austenite phase depending on their content in the steel and on the heat treatment condition. Since the austenite phase relates to the formability, higher percentage of austenite phase improves more the formability. Accordingly, if the steel composition and the heat treatment condition are adjusted to increase the percentage of austenite phase, and if the amount of (C + N) in the austenite phase is increased, the austenite phase can be stabilized, and appropriate degree of stain-induced transformation is obtained during working, thereby attaining excellent workability. To do this, it is required to establish 10% or more of the percentage of austenite phase, and 0.16% by mass or more of the amount of (C + N) in the austenite phase. If the amount of (C + N) in the austenite phase is smaller than 0.16% by mass, the austenite phase becomes ~~instable~~ unstable, and a large part of the austenite phase transforms to martensite phase during working to deteriorate the ductility, thus the increased percentage of austenite phase cannot improve

the press-formability. The limitation of the percentage of austenite phase to 85% or smaller is given because higher than 85% thereof increases the SCC sensitization, which is unfavorable.

The stainless steel sheet ~~according to the present invention is required to~~may be an austenitic-ferritic stainless steel sheet containing particularly 3% by mass or less Ni, composed mainly of austenite phase and ferrite phase. That is, ~~the present invention is based on the finding of~~we found significant effect of the percentage of austenite phase and the amount of (C + N) in the austenite phase in the austenitic-ferritic stainless steel sheet containing 3% by mass or less Ni on the press formability.

Furthermore, ~~the inventors~~we found that, in the austenitic-ferritic stainless steels ~~according to the present invention~~herein, further high ductile characteristic can be attained, or 48% or larger total elongation can be attained even at 0.8 mm in sheet thickness, by controlling the strain-induced martensite index (Md(γ)) of austenite phase to a range from -30 to 90. The strain-induced martensite index (Md(γ)) of austenite phase is defined by the formula (1) as the function of content of C, N, Si, Mn, Cr, Ni, Cu, and Mo in the austenite phase:

$$\begin{aligned} \text{Md}(\gamma) = & 551 - 462(\text{C}(\gamma) + \text{N}(\gamma)) - 9.2\text{Si}(\gamma) - 8.1\text{Mn}(\gamma) - 13.7\text{Cr}(\gamma) - 29\text{Ni}(\gamma) - 29\text{Cu}(\gamma) \\ & - 18.5\text{Mo}(\gamma) \quad (1) \end{aligned}$$

where, C(γ), N(γ), Si(γ), Mn(γ), Cr(γ), Ni(γ), Cu(γ), and Mo(γ) are respectively C content (% by mass), N content (% by mass), Si content (% by mass), Mn content (% by mass), Mo content (% by mass), Ni content (% by mass), Cu content (% by mass), and Cr content (% by mass) in the austenite phase.

Kindly replace paragraph [0057] with the following:

As described above, the austenitic-ferritic stainless steels ~~according to the present invention~~has~~herein~~ have not only ~~the~~ excellent ductility, but also ~~the~~ high deep drawability. The reason of the

superior characteristics is presumably as follows. During the deep drawing, particularly at a corner where the strain concentrates to readily induce cracks, the hardening caused by the strain-induced martensite transformation occurs to an appropriate degree by the same reason with the above-described improvement effect of the percentage of austenite phase and the amount of (C + N) in the austenite phase on the ductility, thus improving the ductility, thereby suppressing the local deformation.

Kindly replace paragraph [0059] with the following:

- C: 0.2% by mass or less

Carbon is an important element to increase the percentage of austenite phase and to increase the stability of austenite phase by enriching itself in the austenite phase. To attain the effect, 0.003% by mass or more of the C content is preferred. If, however, the C content exceeds 0.2% by mass, the heat treatment temperature to form C solid solution significantly increases, which deteriorates the productivity. Accordingly, the C content is limited to 0.2% by mass or less. Preferably the C content is less than 0.15% by mass. In view of improvement in the stress corrosion cracking resistance, the C content is more preferably less than 0.10% by mass, and most preferably 0.05% by mass or less. If the C content is 0.2% by mass or less, the corrosion resistance at welded part becomes excellent at any of weld bead, heat affecting zone, and mother material. The excellent corrosion resistance at these parts can be confirmed in Example 4 described later. If, however, the C content is 0.10% by mass or more, the stress corrosion cracking resistance is significantly deteriorated. Therefore, the C content in the present invention is specified to 0.2% by mass or less, and when the stress corrosion cracking resistance is emphasized, the C content is limited to less than 0.10% by mass, preferably 0.05% by mass or less. The reason of the specified range can be confirmed in Table 10 and Table 11 in Example 5 described later.

Kindly replace paragraph [0068] with the following:

The austenitic-ferritic stainless steel ~~according to the present invention~~ can contain Cu and Mo by the amounts given below, other than the above-ingredients.

Kindly replace paragraph [0071] with the following:

Furthermore, the stainless steel ~~according to the present invention~~ may contain, other than the above-ingredients, V, Al, B, Ca, Mg, REM, and Ti by the amounts given below.

Kindly replace paragraphs [0076] through [0078] with the following:

Balance of above-ingredients in the steel ~~of the present invention~~ is Fe and inevitable impurities. As of these impurities, O (oxygen) is preferably limited to 0.05% by mass or less from the point of prevention of occurrence of surface flaws caused by inclusions.

Regarding the method for manufacturing the steels ~~of the present invention~~herein, it is important to adjust the steel composition and the annealing condition (temperature and time) in the final annealing step, as described above, to bring the volume percentage of austenite phase to a range from 10 to 85%, or further to bring the amount of (C + N) in the austenite phase to a range from 0.16 to 2% by mass.

Specifically, lower content of Cr, Si, and Mo, and higher content of C, N, Ni, and Cu increase more the percentage of austenite phase. Regarding the annealing temperature, excessively high annealing temperature decreases the percentage of austenite phase, and excessively low annealing temperature induces precipitation of C and N as carbide and nitride to decrease the amount of solid solution, which decreases the contribution to the formation of austenite phase, thereby also decreasing the percentage of austenite phase. That is, there is a temperature range to attain the maximum percentage of austenite phase depending on the steel composition, and the temperature range at the composition ~~according to the present invention~~ is from 700°C to 1300°C. Longer

annealing time is more preferable because the percentage of austenite phase comes close to the one in equilibrium state determined by the steel composition and the temperature. Nevertheless, about 30 seconds or more of the annealing time is sufficient.

Kindly replace paragraph [0080] with the following:

If the steel ~~according to the present invention~~ is a hot-rolled sheet without undergoing the final annealing step, the finish temperature of the hot-rolling step is preferably controlled to a range from 700°C to 1300°C. If the steel ~~according to the present invention~~ is a hot-rolled and annealed sheet, the annealing temperature of the hot-rolled sheet is preferably limited to a range from 700°C to 1300°C. If the steel ~~according to the present invention~~ is a cold-rolled and annealed sheet, the final annealing temperature after the cold-rolling is preferably controlled to a range from 700°C to 1300°C.

Kindly replace paragraph [0082] with the following:

For example, the manufacturing method may be the ones given below. The steel ~~according to the present invention~~, however, is not limited to those ones.

Kindly replace paragraph [0086] with the following:

With any of the hot-rolled steel sheets, the hot-rolled and annealed sheets, and the cold-rolled and annealed sheets, the desired effect ~~of the present invention~~ is attained by adopting the manufacturing conditions that the volume percentage of the austenite phase in the steel is adjusted to a range from 10 to 85% or that further the amount of (C + N) in the austenite phase are adjusted to a range from 0.16 to 2% by mass. The effect ~~of the present invention~~ is attained in any surface-finished state (No.2D, No.2B, BA, buff-finish, and the like specified in JIS G4305(2003)). Furthermore, the effect ~~of the present invention~~ is attained not only on the above rolled sheets but also on wires, pipes, shape steels, and the like.

Kindly replace paragraph [0089] with the following:

<Structure observation>

The cross sectional structure of each of the above cold-rolled and annealed sheets in the rolling direction was observed in a range of (total thickness x 0.1 mm) or more using a light microscope. The area percentage of the austenite phase was adopted as the percentage of austenite phase. The determination procedure is the following. The cross section of a sample in the rolling direction was polished, then the section was etched by a red prussiate solution (potassium ferricyanide 30 g + potassium hydroxide 30 g + water 60 ml) or an aqua regia. The etched section was photographed in monochrome. The image analysis was given to the photograph to determine the percentage of white section (austenite phase and martensite phase) and of gray section (ferrite phase). The percentage of white section is adopted as the percentage of austenite phase. Although the white section may include martensite phase other than the austenite phase, the value determined by the method can be adopted as the percentage of austenite phase because the stainless steel according to the present invention contains only a small amount of martensite phase. The white section and the gray section may be inversed in some cases. In that case, however, the austenite phase can be differentiated from the ferrite phase based on the precipitation configuration of the austenite phase.

Kindly replace paragraphs [0093] through [0095] with the following:

The result of the above test is given in Table 2. Figure 1 shows the effect of the amount of (C + N) in the austenite phase and the percentage of austenite phase on the total elongation, which effect is derived from Table 2. Figure 1 shows that, even the same percentage of austenite phase, the steels of the present invention which having 0.16 to 2% by mass of the amount of (C + N) in the austenite

phase gives high elongation and gives excellent ductility compared with those of the steels containing less than 0.16% by mass of the amount of (C + N) in the austenite phase.

Figure 2 shows the effect of the strain-induced martensite phase index ($Md(\gamma)$) on the elongation, based also on the result given in Table 2. Figure 2 shows that even the steels ~~of present invention~~ which have 0.16 to 2% by mass of the amount of (C + N) in the austenite phase further improve the characteristic by controlling the $Md(\gamma)$ value in an appropriate range, and that, particularly when the $Md(\gamma)$ value is controlled to a range from -30 to 90, significantly superior ductile characteristic of 48% or more of total elongation (at 0.8 mm in sheet thickness) is attained.

Figure 3 shows the relation between the total elongation and the limited drawing ratio (LDR). Figure 3 shows that the austenitic-ferritic stainless steels ~~according to the present invention~~ have very large LDR compared with that of the comparative steels, and have not only high ductility but also excellent deep drawability.

Kindly replace paragraph [0100] with the following:

The analytical results are given in Table 4. In addition, Fig. 4 shows the effect of the Ni content in the steel, the percentage of austenite phase, and the amount of (C + N) in the austenite phase on LDR. The result shows that the austenitic-ferritic stainless steel sheets satisfying the selected conditions ~~of the present invention~~, or containing 1 to 3% by mass of Ni, 10 to 85% of austenite phase, and 0.16 to 2% of (C + N) amount in the austenite phase, gave as high as 2.1 or more of LDR, showing excellent deep drawability. To the contrary, the austenitic-ferritic stainless sheets containing the austenite phase outside the range of 10 to 85% and/or containing the amount of (C + N) in the austenite less than 0.16% by mass gave LDR as low as below 2.1, showing poor deep drawability. The austenitic-ferritic stainless steel sheets containing more than 3% by mass of Ni, even with the percentage of austenite phase and the amount of (C + N) in the austenite phase within

the selected range of the present invention, showed LDR as low as smaller than 2.1, giving poor deep drawability.

Kindly replace paragraphs [0103] and [0104] with the following:

Depending on the desired uses, ~~the present invention provides~~we provide steel sheets emphasizing the improvement in the following-described (2) punch stretchability and crevice corrosion resistance, (3) corrosion resistance at welded part, or (4) intergranular corrosion resistance, as well as the above-described (1) high formability with excellent ductility and deep drawability. To do this, the following-specification is applied. The aspects described below are also within the selected range of the present invention.

(2) Austenitic-ferritic stainless steel having excellent punch stretchability and crevice corrosion resistance

Compared with the austenitic stainless steels and the ferritic stainless steels containing 15 to 35% by mass of Cr, or similar Cr content with that in ~~the our~~ steels ~~according to the present invention~~, superior crevice corrosion resistance is provided by the addition of 1.2% by mass or less Si, 2% by mass or less Mn, and 1% by mass or less Ni to ~~the those~~ steels ~~according to the present invention~~ having the compositions described above (1): a steel containing 0.2% by mass or less C, 4% by mass or less Si, 12% by mass or less Mn, 0.1% by mass or less P, 0.03% by mass or less S, 15 to 35% by mass Cr, 3% by mass or less Ni, 0.05 to 0.6% by mass N, and balance of Fe and inevitable impurities; a steel further containing one or more of 4% by mass or less Mo and 4% by mass or less Cu; a steel further containing 0.5% by mass or less V; a steel further containing 0.1% by mass or less Al; or a steel further containing one or more of 0.01% by mass or less B, 0.01% by mass or less Ca, 0.01% by mass or less Mg, 0.1% by mass or less REM, and 0.1% by mass or less Ti, (without specifying the amount of (C + N) in the austenite phase). A presumable cause of the superior crevice

corrosion resistance of the austenitic-ferritic stainless steels is that the enrichment of Cr in the ferrite phase and of N in the austenite phase strengthened the passive film of each phase.

Kindly replace paragraphs [0107] and [0108] with the following:

- Mn: 2% by mass or less

The Mn content is particularly important to attain excellent punch stretchability and crevice corrosion resistance. To attain the effect, 0.04% by mass or more of the Mn content is preferred. Figure 5 is a graph showing the effect of Mn content on the punch stretchability (Erichsen value) in the austenitic-ferritic stainless steels containing 1% by mass or less Ni and 40 to 50% by volume of austenite phase. As seen in the figure, Mn significantly affects the punch stretchability, and 2% by mass or less of the Mn content significantly improves the formability. The reason of the improvement is not fully analyzed, and the phenomenon does not affect ~~the~~our ~~concepts (ranges) of the present invention.~~ A cause of the phenomenon is that small Mn content significantly decreases the Mn concentration in the ferrite phase, thereby significantly improving the ductility of ferrite phase.

Figure 6 is a graph showing the effect of the Mn content on the result of outdoor exposure test of austenitic-ferritic stainless steel sheets containing 1% by mass or less Ni and 40 to 50% by volume of austenite phase. The judgment A is “no corrosion occurred”, the judgment B is “crevice corrosion appeared”, and the judgment C is “corrosion appeared on both crevice zone and mother material part”. When the Mn content is 2% by mass or less, favorable crevice corrosion resistance is attained. Although the cause of the phenomenon is not fully analyzed and does not affect ~~the~~our ~~concepts (ranges) of the present invention,~~ a reason is that the small Mn content induces the decrease in the amount of inclusions, such as MnS, that inversely affect the crevice corrosion resistance. Based on the findings given in Fig. 5 and Fig. 6, the Mn content is limited to 2% by mass or less, and

preferably 1.5% by mass or less, to attain satisfactory characteristics relating to the punch stretchability and the crevice corrosion resistance.

Kindly replace paragraphs [0110] and [0111] with the following:

~~The~~Our steels ~~according to the present invention are required to~~ have the above-compositions and ~~to be~~ the austenitic-ferritic stainless steels having the metal structure containing 10 to 85% by volume of austenite phase.

Figure 7 is a graph showing the relation between the percentage of austenite phase and the punch stretchability (Erichsen value) of austenitic-ferritic stainless steel sheets which contain 2% or less Mn and 1% or less Ni, by mass. As seen in the figure, the punch stretchability improves with the increase in the percentage of austenite phase, giving specific improvement in the punch stretchability at 10% by volume or more of the percentage of austenite phase, and particularly at 15% by volume thereof. ~~According to the present invention, however~~However, the Ni content is limited to 1% by mass or less because of economy, and in that case therefore, the percentage of austenite phase becomes difficult to exceed 85% by volume. Consequently, the present invention limits the percentage of austenite phase to a range from 10 to 85% by volume, and preferably from 15 to 85% by volume.

Kindly replace paragraph [0113] with the following:

To further assure the ductility and the deep drawability, however, the austenitic-ferritic stainless steels ~~according to the present invention are~~ preferably limited to have the amount of (C + N) in the austenite phase of the steel structure in a range from 0.16 to 2% by mass. If the amount of (C + N) in the austenite phase of the steel structure is less than 0.16% by mass, satisfactory ductility and deep drawability cannot be obtained. On the other hand, the amount of (C + N) more than 2%

by mass is difficult to attain. Preferably, the amount of (C + N) is limited to a range from 0.2 to 2% by mass.

Kindly replace paragraph [0120] with the following:

(3) Austenitic-ferritic stainless steel having excellent formability and further having excellent corrosion resistance at welded part

The steels ~~according to the present invention are required to be the~~ austenitic-ferritic stainless steels which have the compositions described above (1), (a steel containing 0.2% by mass or less C, 4% by mass or less Si, 12% by mass or less Mn, 0.1% by mass or less P, 0.03% by mass or less S, 15 to 35% by mass Cr, 3% by mass or less Ni, 0.05 to 0.6% by mass N, and balance of Fe and inevitable impurities; a steel further containing one or more of 4% by mass or less Mo and 4% by mass or less Cu; a steel further containing 0.5% by mass or less V; a steel further containing 0.1% by mass or less Al; or a steel further containing one or more of 0.01% by mass or less B, 0.01% by mass or less Ca, 0.01% by mass or less Mg, 0.1% by mass or less REM, and 0.1% by mass or less Ti, while these austenitic-ferritic stainless steels particularly have 1.2% by mass or less Si, 4 to 12% by mass Mn, and 1% by mass or less Ni, and have 10 to 85% by volume of the austenite phase in the metal structure.

Kindly replace paragraph [0124] with the following:

As seen in Fig. 9, the Mn content at or above 4% by mass definitely and significantly improves the corrosion resistance of the welded material. ~~The inventors of the present invention speculated~~We believe that the cause of the improvement in the corrosion resistance is as follows. When the Mn content increases to 4% by mass or more, the precipitation temperature of chromium nitride decreases, which suppresses the formation of chromium nitride and further the generation of chromium-depletion zone at the welded part and the heat-affecting zone near the welded part. As

seen in Fig. 9, however, when the Mn content exceeds 12% by mass, excellent corrosion resistance cannot be attained. The cause is presumably that the Mn content of higher than 12% by mass induces the formation of many corrosion origins such as MnS in the mother material part. Therefore, the Mn content is limited to a range from 4 to 12% by mass, preferably 5.2 to 10% by mass, and more preferably less than 6.8% by mass.

Kindly replace paragraphs [0127] through [0129] with the following:

Although the cause of the phenomenon does not affect the interpretation of the technical range of the present invention, ~~the inventors of the present invention speculate~~ we believe that the cause thereof is as follows. ~~General~~ Our general understanding is that the austenitic-ferritic stainless steels having small Ni content and large N content show high diffusion rate of Cr and N during cooling step after welding, which induces precipitation of chromium nitride at grain boundaries containing ferrite phase, thereby likely generating the chromium-depletion zone. However, since the austenitic-ferritic stainless steels having austenite phase by 10% by volume or more, particularly 15% by volume or more, as in the case of the present invention, have high performance to form austenite phase, even when Cr decreases at the grain boundaries containing ferrite phase, the portion transforms to the austenite phase to increase the solubility of chromium nitride, thus resulting in the decrease of the chromium-depletion zone.

If, however, the percentage of austenite phase exceeds 85% by volume, the sensitization of stress corrosion cracking significantly increases. Therefore, ~~the present invention~~ we limits the percentage of austenite phase to a range from 10 to 85% by volume, and preferably from 15 to 85% by volume.

To further assure the ductility and the deep drawability, the austenitic-ferritic stainless steels ~~according to the present invention~~ are preferably limited to have the amount of (C + N) in the

austenite phase of the steel structure in a range from 0.16 to 2% by mass. If the amount of (C + N) in the austenite phase of the steel structure is less than 0.16% by mass, satisfactory ductility and deep drawability cannot be obtained. On the other hand, the amount of (C + N) more than 2% by mass is difficult to attain. Preferably, the amount of (C + N) is limited to a range from 0.2 to 2% by mass.

Kindly replace paragraph [0139] with the following:

(4) Austenitic-ferritic stainless steel having excellent intergranular corrosion resistance

~~The~~Selected steels according to the present invention are the steels ~~having~~have the compositions described above (1), (a steel containing 0.2% by mass or less C, 4% by mass or less Si, 12% by mass or less Mn, 0.1% by mass or less P, 0.03% by mass or less S, 15 to 35% by mass Cr, 3% by mass or less Ni, 0.05 to 0.6% by mass N, and balance of Fe and inevitable impurities; a steel further containing one or more of 4% by mass or less Mo and 4% by mass or less Cu; a steel further containing 0.5% by mass or less V; a steel further containing 0.1% by mass or less Al; or a steel further containing one or more of 0.01% by mass or less B, 0.01% by mass or less Ca, 0.01% by mass or less Mg, 0.1% by mass or less REM, and 0.1% by mass or less Ti, (without specifying the amount of (C + N) in the austenite phase)), while these steel sheets have 0.4% by mass or less Si, 2 to 4% by mass Mn, and 1% by mass or less Ni, and the structure of the austenitic-ferritic stainless steels of the present invention has 10 to 85% by volume of the austenite phase in the total structure.

Kindly replace paragraph [0141] with the following:

- Si: 0.4% by mass or less

The limitation of Si content is important in the present invention. Silicon is an effective element as deoxidizer, and it can be added at need. To attain the effect, 0.01% by mass or more of the Si content is preferable. If, however, the Si content exceeds 0.4% by mass, the degree of solid solution of N decreases, which often deteriorates the corrosion resistance because of the sensitization

described in the ~~description of background art~~ “Background.” Therefore, the Si content is limited to 0.4% by mass or less, and preferably 0.38% by mass or less.

Kindly replace paragraph [0145] with the following:

To further assure the ductility and the deep drawability, the austenitic-ferritic stainless steels ~~according to the present invention~~ are preferably limited to have the amount of (C + N) in the austenite phase of the steel structure in a range from 0.16 to 2% by mass. If the amount of (C + N) in the austenite phase of the steel structure is less than 0.16% by mass, satisfactory ductility and deep drawability cannot be obtained. On the other hand, the amount of (C + N) more than 2% by mass is difficult to attain. Therefore, preferably the amount of (C + N) is limited to a range from 0.2 to 2% by mass.

Kindly replace paragraph [0150] with the following:

As shown in Table 14A, the steels No. 1 and No. 2 ~~which are the steels of the present invention~~ gave no crack caused by corrosion at grain boundaries, and showed superior intergranular corrosion resistance. To the contrary, the steels No. 3 and No. 4 which are the comparative examples gave cracks by corrosion at the grain boundaries.

Kindly replace paragraphs [0153] and [0154] with the following:

INDUSTRIAL APPLICABILITY

The technology relating to the austenitic-ferritic stainless steels ~~according to the present invention~~ herein is not limited to the steel sheets. For the case of application to, for example, thick plates, shape steels, wires and rods, and pipes, there can be provided, adding to the excellent ductility and deep drawability, excellent punch stretchability, crevice corrosion resistance, corrosion resistance at welded part, and intergranular corrosion resistance, by satisfying the conditions of the present invention.

In addition, the steel sheets ~~according to the present invention~~ are favorably applied as the base materials of automobile members, kitchenware, building brackets, and the like.